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Content in the Science Curriculum

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WITH THE explosion of knowledge in science, questions arise as to who should select facts, concepts, and generalizations for students to attain. The balance of this paper will explore diverse schools of thought emphasizing subject matter to be emphasized in the science curriculum.

The Structure of Knowledge

A valid means in selecting subject matter for student acquirement might emphasize academicians in the science disciplines choosing vital content. Thus, knowledgeable astronomers, biologists, botanists, geologists, zoologists, chemists and physicists need to agree upon key generalizations. The chosen conclusions might then be emphasized as objectives in the science curriculum. Relevant learning activities guide students in attaining the vital ends, after which evaluation techniques need emphasis to ascertain learner progress.

In emphasizing structural content, King and Brownell quote the following pertaining to the thinking of Jerome Bruner :

Bruner hypothesizes that learning structures of disciplines :

Is learning how things are related.
Makes a subject more comprehensible.
Slows forgetting.
Permits reconstruction of detail through patterns.
Is the main road to transfer of training.
Narrows the gap between advanced and elementary knowledge.
Leads to intellectual excitement.
Supplies bases for and enhances intuitive thinking.
Is the bridge to simplicity. (Therefore structures can be taught to anybody in some honest form).
Provides a path for progression of learning in each discipline.

Bruner further advocated that students learn to utilize methods of inquiry as emphasized by academicians in their academic areas of speciality. Thus, in the science curriculum, inductive methods of acquiring content are recommended. Laboratory approaches need to be a definite part of each science unit.

Why might the structure of knowlegde approach be relevant to stress ?

1. Subject matter specialists have selected vital content for student attainment. Trivia may then be minimized in ongoing units of study.
2. By utilizing methods of study advocated by scientists in their respective disciplines, learners may well glean worthwhile content as well as use valid approaches in attaining major generalizations.
3. Science teachers secure valuable help in developing the curriculum by incorporating content advocated by scientists.

4. Relevant objectives may be chosen by teachers when incorporating structural ideas as well as methods of inquiry used by academicians in the world of science.
5. Science teachers can select a variety of activities to achieve the chosen objectives. These include laboratory methods, excursions, slides, films, filmstrips, textbooks, workbooks, supplementary reading materials, transparencies, objects, models, illustrations, and drawings. The science teacher needs to be a creative being in guiding students to attain worthwhile objectives.

Reinforcement Theory

If students are successful in achievement, reinforcement is then in evidence. To achieve continuously, students need to acquire sequential small bits of vital subject matter. Attempting to master a larger amount of content at a specific time is not advocated. Thus, in programmed texts or using computer assisted instruction (CAI), the involved learner reads several sentences, responds to a completion item, then checks his/her response with that given by the programmer. If the response was correct, reinforcement is in evidence. If incorrect, the student knows the correct answer and is also ready for the next item. A similar/same approach in programmed learning may be used again and again—read, respond, and check.

Woolfolk and Nicholich wrote the following :

> The linear approach is often referred to as Skinnerian programming, because Skinner was its founder and prime advocate. One of its most notable features is that students must actively create an answer, not just select one from a multiple-choice format. They cover the correct response until they are ready to check their own answer. In linear programs students move through a fixed sequence of frames designed to lead them from one concept to the next with as few errors as possible. If students do make a wrong response, they learn of their error immediately, see the correct answer, and move on the next frame.
>
> Linear programmers tend to believe that students should make errors on no more that 5-10 per cent of the frames. In order to keep errors at this low level, the developers of the programs pilot-test the frames, identifying those frames that give students the most trouble. These error-causing frames are then improved or broken down into smaller steps to make success more likely.

Why is reinforcement theory important to emphasize ?

1. learners can be successful in almost every sequential step in learning.
2. a small bit of context is learned before a student checks his/her response. Thus, misunderstanding of subject matter is minimized. A check is made of a learner's response before moving on to the next sequential item.
3. the programmer, a specialist in subject matter content, sequences content for learners. Relevant ideas are then in the offing for student learning.
4. appropriate order (sequence) in learning optimizes student achievement.
5. by building on specifics in knowledge, a learner may ultimately achieve major generalizations and main ideas.

Humanism and the Science Curriculum

Humanists also have much to contribute in developing the science curriculum. A devout humanist believes that learners should have considerable input in ongoing lessons and units.

Teacher-pupil planning may be utilized to select objectives, learning activities, and evaluation procedures. Students should then perceive increased purpose in learning. They are involved in determining what is to be learned, the means of learning, as well as appraising progress.

A second approach in emphasizing humanism in the science curriculum may involve the use of learning centres. The following centres are given as examples : audio-visual aids ; models and objects ; experimentation and demonstration ; problem solving ; excursions ; reading and writing ; as well as a creative endeavors centre. Tasks may be written on a card with one task card per centre. Learners can select which sequential tasks to pursue and which to omit. Continuous progress on the part of each student is vital.

A third method might emphasize a contract system. Each student with teacher guidance develops a contract. The interests and purposes of the involved learner are involved in developing the contract. Once agreed upon, the learner and the instructor sign the agreement with the due date of requirements attached. The goals of learning are decided upon cooperatively by the student and the involved teacher.

A fourth method of stressing the psychology of humanism emphasizes the teacher writing and discussing listed topics for students to pursue. The topics listed on the chalkboard reflect subject matter that students may learn. For example, if ten questions are listed on the chalkboard, chosen by the teacher, the student may complete any five as a minimum requirement.

Pertaining to humanistic education, Combs wrote :

There are two frames of reference for looking at human behavior available to us. One of these is the external or objective approach familiar to most of us as the traditional view of American psychology. Seen from this frame of reference behavior is described from the point of view of the outside observer, someone looking on at the process. Its classic expression is to be found in the various forms of stimulus-response psychology which seeks the explanation of behavior in the observable forces exerted upon the individual. The perceptual psychologist takes a different view. He seeks to understand the behaver of people from the point of view of the behaver himself. His is a phenomenological understanding of human behavior, emphasizing the meaning of events to the person.

Perceptual psychology is basically a field theory and its primary principle is this : All behavior, without exception, is a function of the behaver's perceptual field at the instant of behaving. I am using the term perceptual here in its broadest sense as practically synonymous with meaning. Thus, the individual's behavior is seen as the direct consequence, not of the fact or stimulus with which he is confronted, but the meaning of events in his peculiar economy.

Inherent in humanism are the following tenets :

1. students need to become proficient in decision-making skills.
2. self-fulfillment on the part of the involved student is significant to emphasize in personally choosing what to learn.
3. learners feel increasingly secure and develop feellings of belonging in a humane learning environment.

4. each student perceives significance in learning. The teacher cannot determine relevance for learners.
5. sequence in learning resides within the student, not with teacher determined content for student acquisition.

Conclusion

There are selected philosophies of education which might well provide guidance in developing the science curriculum. The following are recommendable philosophies to consider, adopt, or modify :

1. structural ideas identified by academicians which students may achieve inductively on their own unique levels of understanding.
2. reinforcement theory with sequential programmed steps of subject matter to be acquired by students. Success in learning is inherent, thus providing for reinforcing (rewarding) of desired achievement.
3. humanism which advocates learners choosing sequential content within a flexible structure. Student input is involved in selecting objectives, learning activities, and evaluation procedures.

Teachers and supervisors need to study and analyze diverse philosophies with the intent of selecting criteria which guide each student to achieve optimally in the science curriculum.

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Measuring the Moon's Period of Revolution Round the Earth

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THE THIN crescent of the moon first becomes visible on the second day after the new moon. You have to look for this young moon immediately after the sunset near the western horizon. The moon will gradually move in a westward direction and will finally set in the western horizon. This apparent diurnal motion of the moon from the east to the west is due to the earth's rotation from the west to the east.

Next day watch the moon again at the same time. You will find that the crescent of the moon has become a little thicker, and it is at a higher altitude from the western horizon when compared to its position of the previous day. That is, in one day the moon has moved away considerable distance in the eastern direction. This motion is distinctly different from the apparent diurnal motion of the moon from the east to the west.

Moon's Phase

Day after day the moon's phase will become thicker and thicker as it moves towards the east (also, away from the sun). On the 7th day (*Saptami*) after the new moon, immediately after the sunset, the moon will be found on the meridian, the vertical plane passing through the earth's geographical north-south direction. One-half of its disc will be sunlit. This phase of the moon is called the first quarter. After this, more than half of the moon's disc will be illuminated with sunlight, and this is called the gibbous phase. One or two days before the full moon, the moon will be near the eastern horizon immediately after sunset. Thus if you watch the moon's position in the sky at the same time every day, you will see that it moves from the west to the east day after day. This is due to the revolution of the moon round the earth. This fact has been known to the people of all ancient civilisations for thousands of years.

On the full moon day, as soon as the sun sets in the west the moon rises in the east. On this day, the sun and the moon are on two opposite sides of the earth. After the full moon day, the moon is found to *rise* later and later every night. Actually, this later rise takes place on all days. But one might have missed to observe it during the bright half of the lunar month (*Shukla Paksha*) when the moon rises in the east during the day time. On the average the moon rises 50 minutes later every day.

After the full moon day the moon becomes gibbous again and this gibbous phase decreases day after day. On the 7th day after the full moon, the moon rises at midnight and again one-half of its disc is illuminated. This phase is called the third quarter. After this the moon again becomes crescent. That is, during the dark half of the lunar month (*Krishna Paksha*) moon's phases are repeated in the reverse order. One or two days before the new moon, the moon rises during the time of morning twilight. On the new moon day the moon comes between the sun and the earth and you cannot see the moon at all. Only on some rare occasions you can see the new moon. This opportunity comes during a total solar eclipse. You can then see the jet black colour disc of the new moon surrounded by the sun's corona.

The interval of time between two successive new moons or full moons is called the synodic lunar month. Scientifically speaking, it is the time interval between two successive conjunctions or oppositions of the moon with the sun as seen from the earth. Before the introduction of solar calendar, this interval of time was taken as the length of a month. The term 'month' has actually been derived from the word 'moon'. The Muslim calendar is a lunar calendar and they still use this method. In modern time the lunar calendar has been replaced by solar calendar for all civil purposes. But religious festivals are still observed according to lunar calendar (truly speaking, luni-solar calendar).

The synodic lunar month is not the true period of revolution of the moon round the earth. For measuring the true period of revolution of the moon, the reference point has to be a star which is extremely far away from us and may be considered to be a fixed point with respect to the earth-moon system. This true period of revolution of the moon is called its sidereal period of revolution.

The Vedas and the Moon

The sidereal revolution of the moon has been known to the Hindus at least from the time of the Vedas. They observed that the moon was found near a particular star for one day. Next day it moved near another star. The star near which the moon was found on a particular day was called the *nakshatra* for that day. The moon takes 27⅓ days to revolve round the earth ; and so, there are 27 *nakshatras*, one for each day. The angular space occupied by one *nakshatra* in the celestial sphere is 360°/27 or 13° 20′. The term *nakshatra* is used both for the angular space of 13° 20′ and for the star which marks its position in the sky.

Apart from the *nakshatras* there are 12 zodiacal constellations through which the sun, moon and the planets are found to travel. Each zodiacal constellation (sign) occupies an angular space of 360°/12 or 30° in the celestial sphere. These zodiacal constellations are called *rashis* in India. The moon stays in one *rashi* for 2¼ days. The *rashi* in which the moon is found on a particular day is designated as the *rashi* for that day.

The measurements for these divisions of *rashis* and *nakshatras* are made along the ecliptic, the apparent annual path of the sun through the stars, in the eastward direction from a fixed point near the star zeta-Piscium in the *Nirayana* system of Hindu astronomy.

The period of revolution of the moon round the earth can be measured by watching its position in the background of stars day after day. Knowledge of constellations, particularly of zodiacal constellations, is a pre-requisite for undertaking this exercise. This exercise was done by the author by observing moon's positions from 30th March to 27th April, 1985. The observations were then plotted on a star map (constellation map).

At 8-05 P.M. on March 30 the moon was near the nakshatra *Punarvasu* (star pollux) in *Mithuna rashi* (Gemini). So, the *nakshatra* at that time on that day was *Punarvasu* and the *rashi* was *Mithuna*. The next day, that is, on March 31 the moon was in *Karkat rashi* (Cancer). The *tithi* was *Shukla Dasami*. The bright light of the moon obliterated from view the faint stars near it. Because of this reason moon's position could not be identified among the stars with good precision, and it has not been plotted for this day on the constellation map. The positions of the moon have plotted on all days from April 1 to April 8. There was full moon on 4th/5th April. Thereafter there was dark half of the lunar month (*Krishna Paksha*), and the moon was rising later and later in the night everyday. On the night of 9th/10th April, moon's position was not plotted before midnight, but in the morning time. So, moon's position on April 9th does not appear in the constellation map. The position could not be ascertained on April 11th due to cloud cover. Again, the plotting of position was done everyday from 12th to 14th April. On 15th and 16th April observations were started late, and the stars near the moon could not be identified properly due to morning twilight. For this reason moon's positions have not been plotted for these two days.

New Moon

There was newmoon on April 20th. So the moon was not visible from 19th to 21st April. So, their positions are not marked on the star map for these three days. Because of nearness to the sun and of twilight, position could not be found on 18th April also.

After the newmoon, the thin crescent of the moon first became visible on April 22 during evening twilight. It was not possible to locate moon's position among the stars with the naked eye. But there was a fortunate coincidence. The moon was near the star cluster Seven Sisters (*Krittika*) which can be identified very easily. The cluster was not visible with the naked eye, but could be seen through binoculars. Thus, it was possible to plot moon's position on this day (April 22). This was the only day when some optical aid was used. On all other days observations were made with the naked eye only. Thereafter daily plotting of moon's positions was continued till April 27. On the night of April 27th the author had to go out of Goa for three weeks. So, observations could not be continued beyoud this date. Fortunately, the data gathered were just sufficient for the project undertaken.

The time mentioned in this paper are Indian Standard Time. A day has been reckoned from midnight to the next midnight, and not from sunrise to the next sunrise as is done in the traditional Indian system. It may be noted from the star map that the moon always lies close to the ecliptic.

The positions of the moon plotted in the star map are given in the following table :

Place of observation : Vasco Da Gama (Goa)

Latitude : 15° 23′ North
Longitude : 73° 49′ East

Measurement of Sidereal Period of Revolution

On April 26th the moon has come close to the position it had on the first day of observation, that is, March 30th. The next day, that is, on April 27th it has crossed its position of March 30th. From March 30th to April 26th, the number of days elapsed is 27. The position on March 30th is not exactly at the midpoint between the positions of April 26 and April 27. From eye estimation it is seen from the star map that the moon would require $\frac{2}{5}$th of a day more after April 26 to come to its initial position of March 30. So, the sidereal period of revolution of the moon round the earth is measured to be $27\frac{2}{5}$ days.

The average length of the sidereal period of revolution of the moon is $27\frac{1}{3}$ days ($27^{d}\ 7^{h}\ 43^{m}\ 11^{s}.5$). But due to perturbation in the moon's motion this period may vary by as much as 7 hours.

Calculation of Synodic Period of Revolution

Let T_{sidereal} and T_{synodic} denote the sidereal and synodic periods of revolution of the moon round the earth.

TABLE 1

Date of observation	*Time of observation (IST)*	*Rashi in which the moon was situated*	*Nakshatra in which the moon was situated*	*Phase of the moon*
30.3.85	8-05 P.M.	Mithuna	Punarvasu	Shukla Navami
01.4.85	9-25 P.M.	Karkat	Ashlesa	,, Ekadasi
02.4.85	10-30 P.M.	Simha	Magha	,, Dvadasi
03.4.85	10-25 P.M.	Simha	Purva Phalguni	,, Trayodasi
04.4.85	9-15 P.M.	Kanya	Uttara Phalguni	Purnima (Full moon)
05.4.85	11-00 P.M.	Kanya	Chitra	Krishna Pratipad
06.4.85	11-20 P.M.	Tula	Swati	,, Dvitiya
07.4.85	10-50 P.M.	Tula	Vishakha	,, Tritiya
08.4.85	11-35 P.M.	Vrischik	Anuradha	,, Chaturthi
10.4.85	5-45 A.M.	Vrischik	Jyestha	,, Sasthi
12.4.85	5-45 A.M.	Dhanus	Purva Asadha	,, Astami
13.4.85	5-50 A.M.	Makara	Uttara Asadha	,, Navami
14.4.85	5-30 A.M.	Makara	Sravana	,, Dasami
17.4.85	5-40 A.M.	Kumbha	Purva Bhadrapada	,, Trayodasi
22.4.85	7-55 P.M.	Vrisa	Krittika	Shukla Tritiya
23.4.85	7-50 P.M.	Vrisa	Rohini	,, Chaturthi
24.4.85	7-35 P.M.	Vrisa	Mrigasira	,, Chaturthi
25.4.85	7-55 P.M.	Mithuna	Ardra	,, Panchami
26.4.85	7-40 P.M.	Mithuna	Punarvasu	,, Sasthi
27.4.85	7-25 P.M.	Karkat	Pushya	,, Saptami

The angle through which the moon moves in one day round the earth

$$= \frac{360^\circ}{{}^{T}\text{sidereal}}$$

The angle through which the earth moves in one day round the sun

$$= \frac{360^\circ}{365\frac{1}{4}}$$

= The angle through which the sun moves apparently in one day in its apparent annual motion round the earth through the stars.

It is seen that the monthly motion of the moon and the apparent annual motion of the sun are both in the same direction, that is, from the west to the east.

So, the angle moved by the moon (round the earth) ahead of the sun in one day

$$= 360^\circ \times \left(\frac{1}{{}^{T}\text{sidereal}} - \frac{1}{365\frac{1}{4}} \right)$$

Therefore, the time required by the moon for one complete revolution round the earth with respect to the sun as the reference point is

$${}^{T}\text{synodic} = 360^\circ \div \left[360^\circ \times \left(\frac{1}{{}^{T}\text{sidereal}} - \frac{1}{365\frac{1}{4}} \right) \right]$$

$$\text{or, } \frac{1}{{}^{T}\text{synodic}} = \frac{1}{{}^{T}\text{sidereal}} - \frac{1}{365\frac{1}{4}}$$

By putting the measured value ${}^{T}\text{sidereal} = 27\frac{2}{5}$ days in this relation we get, ${}^{T}\text{synodic} = 29\frac{1}{5}$ days.

The average synodic period of revolution of the moon is a little more than $29\frac{1}{2}$ days ($29^{d}\ 12^{h}\ 44^{m}\ 2^{s}.9$), but it may vary by more than half a day.

Discussion

(1) The term 'period of revolution' of the moon means its revolution round the centre of the earth, that is, geocentric revolution. But in this project moon's positions have been observed from the earth's surface, and not from its centre. The position of the moon among the stars as seen by an observer from the earth's surface will be different from the position observed from the earth's centre. The maximum difference in the observed position of the moon due to this wiil be at a time when the moon is at the horizon, and the magnitude of this maximum difference is nearly 1°. This dierennce can be minimised if the moon is observed when it is close to the meridian. The crucial positions of the moon, plotted in the star map, are of March 30, April 26 and April 27. Computations have been made on the basis of these observations only. At the time of noting positions, the moon was overhead on March 30, about 25° west of zenith on April 26 and about 8° west of zenith on April 27. The error involved due to these factors can be ignored easily if our aim is not to achieve an accuracy of better than $\frac{1}{10}$th of a day.

(2) The representative stars for a few *nakshatras* lie outside their divisional space on the ecliptic. Take for example, the moon's position on April 12. Though the moon has gone beyond the star *Uttara Asadha*, yet it is actually within the limits of divisional space of *Purva Asadha nakshatra*.

Again, see the position of the moon on April 6. It is within the constellation Virgo (*Kanya*). But according to the Indian *Nirayana* system of computation it falls within the divisional space of Libra (Tula). Figures of constellations drawn in the star map follow general international pattern. They have not been drawn according to division of ecliptic region of the celestial sphere by Indian astronomers.

The time for *tithi*, *rashi* and *nakshatra* may vary to some extent from one *panchang* (almanac) to another, depending on the system of computation adopted. The *rashis* and *nakshatras* mentioned in the table have been found out by following the *nirayana* system of Hindu astronomy, and they agree with those given in *Rashtriya Panchang*, published by the Meteorological Department of the Govt. of India. In this *Panchang* modern methods of computation have been used.

(3) The constellation chart given in this article may be used by any one who wants to do this project.

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Enquiry Approach in the Teaching of Science in Schools

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A FRAMEWORK—the curriculum for the ten years schools published by N.C.E.R.T. (1975) gives one objective of education as technicracy: "The child should learn the method of enquiry in science and should begin to appreciate science and technology in the life and world around it." Out of 48 periods per week, each of 30-40 minutes duration, the instructional periods allotted to science are seven. The time for adopting a particular method throughout the academic year being inadequate, a variety of strategies of teaching has to be adopted by a competent teacher.

Teaching Science

The method of teaching science is an important component of curriculum development. Besides transmitting adequate content of science, certain values of science are to be fostered in the minds of the students at primary as well as secondary stages of schooling. That is the latest trend in science education. The N.C.E.R.T. programme of science education started in seventies takes care of the sufficient contents as well as the processes of science. The programme also envisages the active involvement of the school students in the process of learning science. The attainment of this objective gives a measure of the successful implementation of the science education programme. All efforts are, therefore, to be directed towards achieving the objective in the curriculum development. The method of teaching science has a great bearing on the inculcation of desirable scientific values. The style and approach to teaching science has an inherent power to influence the young student to mould them into the cast of a scientific temper. The NCERT experts, in their Teacher's Guides have suggested one method namely enquiry method. Although the Teacher's Guides are a commendable initiative for helping the teachers to incorporate the new approach into their style of teaching of science but the Guides do not discuss the nature of enquiry in sufficient details for the teachers. In this paper I have made a modest attempt to discuss the relevant nature of enquiry and its applications in the development of curriculum for Indian Schools in general and Punjab Schools in particular.

What is an enquiry ? A man tells his wife that there would be a solar eclipse next day. His child asks the father, "What is a solar eclipse ?" Not only the word 'eclipse' but also its import is unusual for the child. Further, the event itself is unusual. In order to satisfy his natural instinct of curiosity, he wants some useful information. Hence he asks a question to know about the solar eclipse. Obviously some thing unknown makes the child ask a question. Traditionally the children were snubbed for their pestering querries.

I do not want to go into the reasons for snubbing the children. That will be a digression. But this practice was educationally as well as psychologically unsound. It was uneducational because it deprived the children from acquiring useful information. It was unpsychological because the repression created fear in the minds of growing children. Not only their thinking faculty was impaired but also they became passive listeners in the classroom. And thus they were denied the opportunities of active involvement in the learning process. The persent trend is to give answer to as many questions as raised by the children. There are two method to satisfy their curiosities. One, telling the child straight away that a part or whole of the sun will not be visible for sometime. And that is it all. No more questions. No more answers. Here the information is passed on to the enquiring child who is just expected to accept the facts told. Secondly, helping the child to discover an answer through an experiment. In the former case the child will be left to do the experiment himself. In the latter case the child will be guided to do the experiment. In the second case the child searches for the answer through the processes of observation, inferences and/or prediction, whereas these processes are denied in the first method.

The New Method

The new method, no doubt, puts a heavy demand on the energies of the teacher because it requires creative planning of curriculum i.e. innovations, cautions and suggestions for good observation. In nutshell this kind of enquiry means some guided activities to explore the contents of Science. And in the process of exploring for information, the additional benefit is the development of scientific temper deeply but subtly in the minds of children. In other words, certain values and methods of science are also learnt. What makes a good curriculum is not simply collecting information but something more is involved. Knowledge is not a power but it is the use of the knowledge that makes it a power. That explains the nature of enquiry which I think under-lies the philosophy of science education programme developed by N.C.E.R.T. The Teacher's Guides, textbooks of science and other curriculum materials, reflecting this philosophy have been adopted or adopted by Indian States including Punjab.

I shall now discuss some aspects of Wilson's model of enquiry which I believe is quite useful for development of curriculum in schools. John T. Wilson, in an article on "Processes of Scientific Enquiry"—A model for teaching and learning of science published in a journal 'SCIENCE EDUCATION' (Vol. 58, No. 1, 1974, p. 127-33) gave the modes of empirical enquiry which could be considered very relevant and appropriate for teaching of science in Indian schools as had been envisaged in the science education programme. He suggested three stages of empirical enquiry, namely, stimuli, search processes and results. Each stage leads to the succeeding one. At each stage, the role of the teacher is that of a guide and philosopher. There are many examples for development of this kind of enquiry approach in the curriculum material developed by the N.C.E.R.T. But it is a mistake to think that this enquiry approach can be applied to the whole of the curriculum material. One reason is that planning will not only require considerable exercise of the teacher's mind but also it is time consuming. Many portions of the curriculum can not be cast into the enquiry approach. But still I believe that the Wilson's Model of empirical enquiry has a great value for science teachers of Indian schools. The Model is reproduced here for those who like to adopt the new method of teaching science.

Empirical Enquiry

Discrepant events :

1. Curious events
2. Data gaps
3. Chance observation

Stimuli

↓

Empirical experiments :

1. Observation
2. Classification
3. Inferring
4. Predicting
5. Quantifying
6. Simplifying

Search Processes

↓

New Phenomena :

— Objects, events
— Observable relationships
— Co-related occurrences

↓

The first set of enquiry processes serve as stimuli for seeking information based on unusual happenings or strange things or odd situations. For a primary school student, an eclipse may be an unusual happening. For a secondary school student, the failure of occurrence of solar eclipse on every Amavas (no-moon) day may be an odd situation. The level of intellectual development has therefore, a bearing on seeking the information about the solar eclipse. The data gaps certainly belong to a higher stage of intellectual development. The case of missing elements in the periodic table is a typical example. It was Mendleefe's sharp intellect who could took into data gaps and suggest the existence of new elements.

The search processes are the essentials of planning and designing a good curriculum. They are quite in tune with the philosophy of science education programme for Indian schools. The influence of the classroom teacher reigns supreme in moulding the young impressionable minds of children. The spirit of enquiry can be inculcated by teachers if they adopt the methods of search in planning their classroom lessons. Awareness of the new method of teaching science is the stepping stone to its acceptance into practice of science teaching. Hence the preservice and inservice teachers should have a thorough acquaintance as well as practice with the search processes to enable them to apply while planning and designing the classroom lesson.

An empirical experiment consists of six major steps, namely, observation, classifications, inferring, predicting, quantifying and simplifying. I shall discuss each of the search process, of course, very briefly for obvious reasons of space but their understanding is very important.

Observations

The first level of observation consists in simple measurement of length, time, mass, temperature, weight, area and volume with some degree of accuracy. The instruments are metre rod, vernier callipers, sphero-meters, watches, miro-meters, spring balance, physical balance, and thermo-meters. Nothing the zero-errors and least count of the instrument is the fundamental though rudimentary observation in the first lesson of scientific thinking. Right from primary class to the second year college science teaching these experiments of observations are repeated but this skill is hardly developed in the students to a degree of usefulness in life. How many can read a clinical thermometer correctly ? Reading of watt-meters, A-meters, volt meters and water meters which need this kind of observation is a tool for obtaining correct information in our lives.

Classification

The classification is another search process. A known data is arranged into a pattern which reveals relationships and helps to recognise differences and similarities. For secondary school science teaching, the process of classification forms an important component of the curriculum. Classification can be defined as putting objects or ideas into groups according to a particular attribute. The typical example is the classification of elements into metals and non-metals according to their attributes. Metals have high densities but the sodium element, though a metal has low density. It is the process of classification that brings into notice the peculiarity of the sodium metal, when different metals are put to the test of experimentation. The search process of classification thus leads to the further enquiry. Thus the search process becomes an aid to enquiry and discovering of more information. The allotropes of phosphorus, sulphur, and carbon are useful examples for learning/teaching of classificational skill in the subject of chemistry. Each of the element is chemically the same but its forms have different physical properties. Comparison is an advanced stage of classification. Two ideas are compared together for differences or similarities. Take for example, mass and weight of Physics. Another good example in Biology is the comparison between the living and non-living objects.

Inferring

Inferring is the third search process of empirical enquiry. A large collection of data by itself, may have no value. But if the data is tabulated it may reveal some useful and valuable information to keen eye. A certain common feature is the general inference among the objects. For example, all tree levels have a green colouring material called Chlorophyl. Thus green colour of the leaves is a feature of healthy growing plants. The Chlorophyl is important for photosynthetic manufacturing of food for the growth of plants. It may happen that looking at several plants in a field. White streeks on leaves are found and that eventually leads to the withering of plants. The obvious inference is that a disease has attacked the leaves. In other words, the kitchen of the plants is choked to stop the manufacturing of the food for the plants. I have taken this example from the secondary school biology textbooks. Visible clues or some other hunch can lead to inferring useful information.

The application of the inferring process is extremely important in the chemical analysis of mixtures as taught to the chemistry students of the secondary schools. One finds another example in the chemistry syllabus for middle classes. How can we infer the hottest part of the flame. The simplest way is to hold a crystal of copper sulphate near the candle flame. And low ! there is a green mantle around the flame. So easy to infer the part of the flame which is hottest.

This search process of inferring can hardly be ignored in the planning of curriculum for science. A creative teacher can find numerous examples from school syllabus for the development of this skill in young students.

Predicting

The fourth search process is predicting which must find a place in curriculum planning for science. This process is quite similar to that of inferring. In the inferring process, some action/event has taken place and an observant eye discovers the oddity in the situation. A well known chemist while studying the composition of air found in an experiment that a bubble of air was invariably left in the jar from which Oxygen and nitrogen were removed. The obvious inference is the presence of some gas which was later confirmed as helium. But, for the search process of predicting, a relationship between two variables is well known. On the basis of the established equation given to one factor, the equation predicts the value of the dependent variable. The value predicted is invariably correct. For the benefit of the teacher, I would like to illustrate by an example. A farmer installed a water-pump operated by an electric motor of 2 KVA. The water is lifted from the well through a tube of certain radius. The relation between the flow of water in one second and the radius of the tube is known. To be more exact the rate of flow of water is in direct proportion to the fourth power of the radius of the tube. The farmer's son has recently graduated in agriculture advises his father to buy the tube of twice the diameter because the discharge of water becomes sixteen times as predicted by the equation. The prediction is true. The father is happy to get so much water for his fields. But soon after the electric motor stops operating. A tube well operator was called in to check. He found the motor coils burnt. The inference is the overloading of the electric pump. I have incidently explained the difference between predicting and inferring from known relation and facts. Perhaps that was difficult example. Let me illustrate by a simple example.

Everybody knows : Newton stated that action and reaction are equal but opposite. What happens to a cracker rocket when its fuse is ignited ? The gases hit the earth with a force that constitutes action. Prediction : the rocket will go up because the earth hits the rocket with an equal force which constitutes the reaction. The secondary school textbooks on physics, chemistry and biology are full of good possibilities for developing this ability among school students.

Quantifying

Quantifying is the fifth search process which demands a definite place in the planning of curriculum for school science students because this ability is significant feature of serious and advanced thinking for solving difficult problems appropriately and taking some hard but correct decisions. Quantifying means expressing the data in terms of symbols and numbers for determining the relationships and evaluating the results. It makes easy to understand vast data. Lord Kelvin has rightly remarked that if a person cannot express the ideas in terms of numbers, however excellent ideas he may have, he has scarcely advanced to the stage of science. He is indeed ignorant of science and its ways. Take for example $S=\frac{1}{2}at^2$.

The symbols have usual meaning as explained in any school textbook. This is a wonderful equation first suggested by the great thinker Galileo. A lot of information on motion of bodies in condensed into this small equation which has tremendous applications in applied science. The equation gives full answer to the problem how far a body goes up in a certain time provided a constant known as acceleration is determined accurately. Indeed this equation sums up the experience of several thinkers including Galileo. The habit of quantifying the results/experiences gives clarity to thought and leads to quick and right decisions.

Simplifying

Simplifying is the sixth search process of an empirical enquiry. This process, in effect, means an experiment in which one variable of the situation is controlled whereas the other factors are kept constant. The best example is that of determining the time of a swing of a pendulum. The time depends upon several factors, say, extent of swing, mass of pendulum, length of wire to which mass is attached. Any of the factors can be controlled with respect to time of swing. The mass and extent of swing does not alter the time of swing. These factors are eliminated and the search is simplified to finding of time of swing with respect to the length of the pendulum. Simplifying thus helps to discard irrelevancies and makes the enquiry useful. Evidently, simplifying as a search process need be learnt by the secondary school students of science. Factors for the growth of plants, namely air, water, nutrition and light are important in the biology curriculum of schools. Many more examples can be quoted for the inculcation of the sprit of enquiry based on the search process of simplifying.

The methods of enquiry has been explained very briefly. I am sure, the knowledge of these methods will stimulate the innovative teacher for application of the enquiry strategy in the development of classroom curriculum, more especially in science groups of mixed abilities. It must, however, be noted that the enquiry does not flow in a sequence of search processes as discussed here to fore. One process or combined with another may be adopted in a teaching strategy based on enquiry approach. *The learner in the classroom must be equipped to differentiate between the outcomes because the student/teacher must recognise what makes a reasonable outcome so that he does not exceed the limits of his enquiry.*

The Role of the Teacher in Promoting Effective Enquiry

The enquiry is always associated with some clues leading to tentative ideas, may be, through the recall of or association with a situation or object. The clue provided at the opportune time directs—the activity towards empirical enquiry. It suggests possible procedure to be adopted for it involves evaluation and rejection/acceptance of alternative answers to the question. Here lies the role of a science teacher. It is the way the teacher acts and provides the necessary clue or ideas for further enquiry. The student can not act the way a scientist would for the simple reason of lack of adequate background of knowledge and experience in regard to acceptance/rejection of some ideas in relation to the onward direction of the activity of enquiry. This aspect of teaching strategy emphasises the role of a teacher as a guide or philosopher. He makes productive suggestions during enquiry search processes of observing, classifying or simplifying of factual information. The guidance provides for building up the confidence to act and decide boldly.

The Curriculum Material

The students textbooks and teacher guides constitute the main curriculum material. The N.C.E.R.T. textbooks on science right from primary to the secondary classes emphasize, the technique of enquiry teaching in classes in accordance with the aim of education noted in the beginning of the article. Therefore the lesson plan i e. development of the curriculum in the classroom should reflect the enquiry approach. The elements of enquiry discussed in this article have great bearing on teacher's style of teaching. A perusal of N.C.E.R.T. teacher's guide especially for primary class teachers provide a set pattern of questions and answers on a particular topic. When the sequence of questions, is followed strictly as laid down in the teacher guides. The role of the science teacher as described in this article becomes limited. This restriction on the role hinders the development of the ability of enquiry among students because initiative of questioning, on the part of the teachers and the free answers by the students would not be acceptable to teachers for the reason of non-conformity with the textual material. The text books contain content i.e. knowledge of science and teacher's guides explain the approach of teaching strategy. The teacher's guides are necessary to create awareness of the new technique of enquiry but the guides must provide enough freedom for teachers to develop the classroom curriculum. In other words, the guides must have sufficient number of models of lesson plans. One way to get a repertory of well designed lesson plans is to organise teaching competitions and to circulate prize lesson plans among school teachers. It is particularly important when one finds that secondary school boards, unlike Nuffield Foundation, has published only science text books. The technique of planning curriculum is only left to the teacher's initiative. It may be true that good teachers are born and not made. But I think, when there is a call for universal education, teachers can be made to apply new methods in the curriculum planning by creating an awareness of innovations through teacher's guides.

I have discussed modes of empirical enquiry with a view to encouraging teachers to adopt the enquiry approach in their curriculum planning. The textbooks provide well organised content but a variety of teaching strategic including the one discussed can be used to develop the abilities of enquiry. The success of teaching can be guaged by degree of science ideas absorbed by the students for application in day-to-day life situations, which need so much of enquiry methods. □

Sleep Physiology

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SLEEP IS the most puzzling phenomenon out of all of our vital functions. How we enter into somnolence, which serum factor promotes the state of sleep, whether there exist a sleeping waking centre or not and the possible exitence of hypnogenic mechanism within the brain have been subject of vast enquiry. Literally, dozens of reviews, books, symposia and monographs have appeared on every aspect of sleep and waking over the last two decades alone, but no one has yet explained in positive and unequivocal terms the nature and purpose of sleep.

The EEG

Discovery of EEG by Berger (1929) triggered the research on sleep physiology. Later on, techniques of brain transection, electrical stimulation, lesion marking, histo-fluorescence or mapping of monominergic neurons and computer sciences served as milestones in the understanding of sleep physiology. Sleep is typically defined operationally with respect to electroencephalogram (EEG), electro-oculogram (EOG), and electromyogram (EMG) that is, "brain waves, eye movement, and muscle tonus", respectively. Recordings are made on Polygraph which receives and amplifies changes in microvolts detected by electrodes attached to the scalp (EEG), on the skin to the right of the right eye and to the left of the left eye (EOG), and just under chin (EMG). During sleep dynamic changes occur in the electrical activity of the cortex and subcortical structures. Even though somewhat imprecise and a physiological oversimplification the continum of sleep is nonetheless divided heuristically into the following three electroencephalographic categories :

I. Wakefulness—It is characterized by a disynchronized EEG pattern consisting primarily of low voltage wave of high frequency.

II. Deep or slow wave sleep—It is characterized by pattern of EEG which is synchronized and dominated by rhythmic high voltage wave, that occur less frequently.

III. Paradoxical sleep—Periodically during sleep, a person usually passes through a state of dreaming associated with mild involuntary muscle jerks with rapid eye movements. The rapid eye movements have given this stage of sleep the name of REM sleep. EEG during these periods are typical of those of light sleep but not of deep sleep. Yet strangely enough, muscle tone throughout the body is diminished almost to zero, the heart rate may be as low as 20 beats below normal, and the arterial blood pressure may be as low as 30mmHg below the normal Thus person seems physiologically to be in very deep sleep. REM sleep occurs 3 to 4 times during each night at intervals of 80 to 120 minutes each occurence lasting from 5 minutes to more than an hour. As much as

50% of infant sleep is REM sleep. In adult 20% is REM sleep. Compared to research on REM sleep in infancy work on aging population has been sparse. Generally, effect of aging on sleep appear to be in the reduction of REM and delta sleep. REM time is related in some way to intelligence, brain power and brain weight.

The Survival Value

Sleep is not the absence of behaviour, as earlier suggested by several authors in this field, rather it is distinctive kind of behaviour. On appearance the behavioural symptoms of sleep can be described in terms of a postural changes, closure of eye lids, an increased depth but decreased rate of respiration and generalized immobility. Sleeping is "a consummatory act" that is induced by sleep deprivation much in the same way that feeding and drinking are induced by food and water deprivation. Hence as suggested by Darwin sleep has survival value and apparently fulfils a biological need. Following sleep deprivation, one's performance tend to be more erratic, more effort is needed to perform well at complex and mental tests, and there is a feeling of drowsiness that becomes more intense as period of deprivation is extended.

Sleep has been classified by some authors as a homeostatic drive. Certainly, all organ system in the body benefit in one way or other by cyclicity in sleep and arousal. Generally it is conceded that sleep is a restorative process that enables the brain and other bodily structures to recover what Sherrington called "wear and tear". The consequences of recovery processes are a reinstatement of physiochemical balance or homeostasis of cerebral structures essential to survival.

Sleep onset is the product of the confluence of a number of events which influence active sleep inducing-areas such as posterior hypothalamus, raphe, solitary tract. Telecephalon is necessary for delta phase of slow wave sleep (NREM) but not for REM sleep. Undoubtedly there are many factors that initiate sleep onset. One of the most reasonable candidate is the hypnogenic substance thought to build up during wakefulness. A typical finding is that cerebrospinal fluid or blood from a sleep-deprived animal can induce sleep in waking animal. Progress in isolating and identifying such a hypnogenic factor has been made.

Jouvet, implicated serotoninergic neurons in slow wave sleep, and catecholaminergic and cholinergic neurons in waking; and formulated the first neurochemical theory of sleep. Raphe nuclei in brain stem contain appreciable quantities of serotonin. The release of serotonin from these nuclei evoke deep sleep. This has been proved experimently. Lesion of raphe nuclei in the brain stem cause prolonged wakefulness. Further, treatment of animals with pchlorophenylanine; a drug which selectively inhibits serotonin synthesis also cause wakefulness in cats. Compounds which increase brain serotonin cause increase slow wave sleep. These facts suggests that serotoninergic nerve fibres from raphe nuclei somehow are capable of initiating the arousal system or stimulating the synchronizing system.

The nucleus coeruleus contains a dense conglomeration of noradrenergic nerve terminals. Jouvet has proposed that ratio of serotonin to norepinephrine within the brain stem maintains each of the several different states of sleep. The balance in the release of these monoamines presumably operates in much the same way as is hypothesized to occur in anterior hypothalamus in the control of body temperature. An overall interpretation of the monoamine theory of sleep suggests that neuronal release of serotonin within the midbrain could evoke deep sleep, whereas synaptic liberation of norepinephrine would trigger the paradoxical state. These two co-ordinated aminergic actions thus would provide the necessary balance between the two major states of sleep, both of which are necessary for physical as well as mental stability. When this mesencephalic nucleus is lesioned, several attributes of paradoxical sleep disappear. However, this has not been consistently replicated because the locus coeruleus also contain cholinergic neurons. Further, drugs that interfere with synthesis of norepinephrine such as disulforam or ∝ methyl-p-tyrosine (∝MPT) suppress paradoxical sleep.

Sleep Physiology

Most of the views on sleep physiology are still riddled with paradox. The type and duration of sleep changes during different phases of life *i.e.* infancy, adulthood and old age. Pattern of sleep also changes during menstural cycle and pregnancy. This suggest some sort of relationship between hormones and sleep, which is yet to be investigated. Intelligence quotient (IQ), physical alertness and life span are also considered somehow related with sleep. This makes this field of sleep physiology interesting but challenging.

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Mobile Science Laboratories in Tamil Nadu

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THE EDUCATION Department of Tamil Nadu is proud to note that Tamil Nadu is the only state in our country which implemented the scheme of Mobile Science Laboratory in the year 1968, for the improvement of Science Education in the Primary, Middle and High Schools of the State. Since then the Mobile Science Units have been working effectively for the promotion of Science Education especially in the rural areas where the schools lack well equipped science laboratories. We also proudly note that the service of the Mobile Science Unit has been extended to the Higher Secondary Schools introduced in this State from the academic year 1978-79. I wish to give a clear picture of the unique scheme, its functioning and its benefits.

This State is divided into 49 educational districts. At present 42 educational districts have been provided with the Mobile Science Units. Each unit is attached to the respective District Educational Offices. In each unit there is a staff of 3 members comprising of one Deputy Inspector (Science Graduate), one driver and one technical assistant-cum-cleaner.

The Mobile Science Van was designed to suit the requirements of rural schools lacking necessary equipment, laboratories, source of power, even a permanent building.

The Mobile Van has been provided with a Primary Science Kit and all sophisticated equipment sufficient to teach Science upto High School level. Steps have been taken to furnish more equipment for the Higher Secondary level also.

The space available in the van has been used in such a way so as to carry almost all the equipment for the programme. In short the Mobile Science van is a complete laboratory on wheels.

All the Science units come under the control of the Assistant Director of School Education (Science Education) Madras.

How the Mobile Science Unit Works

The Science Deputy Inspector prepares his tentative tour programme for every month in consultation with the Deputy Inspectors of Schools in his educational district in advance, gets the programme approved by the District Educational Officer and sends the copies of programme to the respective schools —while preparing the programme, the Deputy Inspector takes into consideration of the school situation and the local availability of materials.

The Mobile Science Unit visits Primary, Middle, High and Higher Secondary Schools every month. Special attention is given to the UNICEF assisted Primary and Middle Schools. The Deputy Inspector who is a competent Science teacher, teaches, demonstrates and does experiments for the benefit of children throughout the day.

Generally 10 to 15 experiments are done daily.

In addition to his regular work, the Deputy Inspector inspects and verifies Science Stock Registers, Issue Registers and Record Note Books of the pupils and of the Science staff. He guides the teacher in maintaining the registers and keeping the Science Kits and other Science articles for effective use.

It is of much importance to note that the Deputy Inspector helps the Primary and Middle School teachers in making their own Improvised Aids. Sometimes he organises voluntary courses for the teachers.

Every Saturday he visits Teacher Association Centres where more than 200 Primary and Middle School teachers meet. He does experiments and gets the doubts of the teachers clarified. These visits are very useful and effective.

Special Duties

The Deputy Inspector when visiting the schools provided with the UNICEF Science Kits, he demonstrates and trains the teacher how to use the kit articles effectively.

He helps the teachers of his educational district to organise range level and district level Science Exhibitions. When the Assistant Director of School Education (Science) organises a State Level Science Exhibition, the Deputy Inspector plays a vital role.

In addition to their regular and special work, he will act as Science Resource Person for the Science Training Programmes conducted by the State Council of Educational Research and Training, Tamil Nadu.

The Work of Deputy Inspector

All the Deputy Inspectors send their monthly reports of the work done during the month to the Chief Educational Officers who in turn consolidate the reports and sends to the Assistant Director of School Education so that some guidelines may be given to the Deputy Inspectors.

They give details in their monthly reports, the number of schools visited, the number of experiments done, the number of pupils benefited, the petrol consumed during the month and the number of kilometres the van ran. The Technical Assistant-cum-Cleaner assists the Deputy Inspector.

Training to the Deputy Inspectors

Periodically, refresher courses have been conducted for the Deputy Inspectors. During the courses, apart from giving new methods of teaching Science, their suggestions to improve the work of Mobile Science Unit are received and necessary action taken.

Providing More Equipment

The Education Department is taking all steps to provide the van all modern Audio-visual equipment like 16 mm. film projector, 35 mm. film strip projector, Tape-recorder etc., in the coming years.

We hope that we will cover all the educational districts of this State providing seven vans to the remaining 7 educational districts. Then the Science Laboratory on wheels will be within the reach of every child in this State.

The Science Deputy Inspectors help the school assistants to organise science club in each school.

This year, Government have sanctioned 4 more Mobile Science Vans at the cost of 4,23,000/- ☐

Acc no- 15127

Recent Trends in Information Technology

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STORAGE of information, its retrival and processing have always played an important role in the progress of human civilization. The advancements in printing technology and other means of communication made it possible to hasten the dissemination and exchange of information on scientific and technological research, thereby increasing the pace of further research. In the last thirty years or so the developments in the field of electronics have brought us on the threshold of another era in the field of information processing. This technology is far more quicker, reliable and easy to use. The advanced countries of the world are already harvesting the benefits of this technology. In India, many of this have already been in use on varying scales mainly owing to exorbitant costs involved in their import. However, in view of recent facilities provided to the electronic industry in the country it is imperative that in the next couple of years many indigenous products will be available in the market which would radically change our present systems of information processing in almost all areas of governmental, industrial and educational works. The purpose of this paper is to create a general awareness about the nature and types of electronic technology now available and its growth trend in the country. In view of the fact that the computer education in different forms has already been introduced in the country, it is expected that this article would also help all those working at various levels in the field of education to have an idea about the implications of the new technology.

Paperless Office

One third of western world workforce is engaged in the office. Terms such as 'paperless office' and the 'office of the future' are now being widely used. A survey show that 71% of companies in western world don't have clear and accurate information on products and systems. Introduction of word processor reduces total office salary cost by 4%. Over 50% workforce in the west is employed in production and processing and distribution of information.

U.K. in one year has introduced 20 office automation pilot schemes while spreading information technology. Recently the UNESCO announced a major initiative in the promotion of information technology in third world countries. Still many company managers remain confused in computing and communication system. Japan and USA are competing to achieve top position in 'high tech' development techniques. Electronic mail, prestel, cable, satellite, fibre optics transmission etc. are being tried and most economic process is being worked out. Besides micro-processor which is most cost effective, facsimile, telex and electronic publishing system are benefitting from the new levels of research and development.

Information storages and retrieval take 25% of a manager's time. This figure is reduced substantially with the application of Information Technology. Communication systems like Local Area Networks (LANS) Wide Area Networks (WANS), Packet Switch Service (PSS), Satellite Micro-wave Links and Fibre Optic Links are being extensively tried. Various speeds of information processing through these links have been achieved, e.g. kilostream (48,000 to 64,000 bits per second) magastream 2 to 140 million bits per second, etc.

The Micros

Instead of one mini-computer or main frame sitting in glory, often micros are found in individual departments each doing its own specialised part of the organisation work; most micros are 8 bit ones. They are used in vehicle schedules, personnel records, pay roll etc. Recently the tendency of using 16 bit micros are being observed. 16 bit ones have the advantage of 5 to 10 times data processing power but very little 16 bit software are around at present. In next couple of years advent of optical disc drive for micros will increase the storage capacity by 1000. 32 bit micro processors are on the way. A micro needs to possess – 8 and/or 16 bits processor, 128 to 256 kbytes of memory, 800 kbytes of backing store, a full screen of 1920 characters, a full key board with comprehensive function keys, a standard operating system and output ports for standard printers. Printers are of two types—Daisy wheel and Matrix. The former has a speed of 20 to 60 characters per second; the latter is more versatile in character repertoires upto 300 CPS. While micros are mostly seen in accounting applications in small farms, mini and main frame cousins are used in larger organisations in different fields. Micros are also used in personnel administration, sales, purchase, stores, welfare and so on.

IBM personal computer (PC) was launched in USA in 1981. The firm claims that today it is the largest selling PC in the world. No of software programmes written for it is over 5000 including word processing, accounting, inventry, managerial, data base management, project management, spread sheet packages, graphics and education packages. The technical data for this micro is :

Processor–16 bit 8088
Memory–256 kb expandable to 512 kb
Storage type–DSDD floppy 5¼″, Winchester Drive
Disc capacity–360 kb floppy, 10 Mb, Winchester Drive
Operating System : MS-DOS.

For using telephones in cars, mobile phone service was once introduced in U.S.A. In this system a single antenna serves an entire city but not more than 12 mobile telephones could be used at one time. So this technology was subsequently replaced by Cellular Radio technology. For this the city is divided into smaller cells each with its own antenna serving only that cell. When a driver passes from one cell to another the call is transferred from one antenna to the next by means of computers.

Fight Against Fraud

While the electronics is bringing revolution in the business of banking, concern is growing for the protection of electronic transaction from fraud. Not much preventive steps have been developed to fight against fraud in the EFT (electronic fund transfer) ; some have suggested the use of 'smart card' which is a plastic card with a computer chip in it. It can encrypt personal details like identification number etc. It was invented more than 10 years ago and tested ; it is now being adopted in France. There is a proposal to test about one lakh smart cards in United

States recently. Those cards are manufactured by one French firm and also by Casio Micro-card Corporation, Tokyo. Biometrix is another method of protecting transactions. It assures the identification of a card user through his biological features that are determined at birth and cannot be changed, such as eye ball pattern, voice tones and signature dynamics. The dynamics of a signature i.e. the pressure and speed etc. can easily be stored in the chip of a small card. Each time the customer signs his name on the 'special pad' during transactions, the dynamics are compared and verified with the help of the chip.

Status in India

Use of computer during 1984 Lok Sabha poll has been a big jump towards adoptation of high technology. The Nehru Planetarium, Appu Ghar (Pragati Maidan), Indian Airlines Corporation, Electronic Exchanges, major news agencies and newspapers (photo composing units and electronically operated information and data processing system, electronic typewriters and word processors, electronic machines, have been installed), hospitals and nursing homes, undertakings like DESU, DDA, DTC etc. have already gone or are in the process of going for computerisation. India's first bilingual (Hindi-English) document preparation system 'Softword' has been developed by a dynamic young electronics group. It has built-in capacity for checking the syntax error in language. It facilitates translation from English to Hindi and also has a comprehensive Hindi-English Dictionary. The same group has also offered system for other foreign languages like Russian, German and French. These programmed machines will be ideal for use in translating and documenting sensitive informations in English where utmost commercial and financial secrecy and confidential documentation are desirable. A word processing system 'LIPI' was demonstrated recently during the Rajya Bhasha Sammelan. A personal computer is now available at Rs. 4990/- (taxes extra) ; a wide range of programmes ranging from Rs. 15 to 80 is available for such a PC ; a TV monitor and a cassette recorder are to be used alongwith this type of computer. Many indigenous software production groups have been successful in bringing out programmes for use in schools on Languages, Mathematics and Science. Reserve Bank of India is studying the possibility of introducing Magnetic Inking Card Technology for processing of cheques. The Punjab National Bank and the Vyasa Bank have recently adopted the Magnetic Ink Character Recognition (MICR) technology in Delhi. This will mainly eliminate the delay in clearance of cheques.

Computer Technology

The Law Ministry is now examining the introduction of computer technology in the working of courts. Taperecorder and other devices like photocopier, telex equipment, microlinking etc. have scopes for introduction mainly to eliminate delay. Computerisation will help to tell the user the Supreme Court views and other documentations of a particular point by merely pressing a finger.

The followings are the claims of M/s Semiconductor Complex Ltd. who is manufacturing Unicorn PC-"Rugged, reliable, specially designed for Indian conditions. Dust, humidity and heat registant and it is the only system that matches military grade specifications. Software packages will be available for the following sections : Education—Nursery Schools, Primary Schools, Higher Classes, Colleges. Professional—medical Practioners, nursing homes, lawyers, technical consultants, architects, management consultants, chartered accounts. Business—restaurants, hotels, general merchants, departmental stores, small/ medium factories, offices, agriculture—dairy, poultry farms".

Another computer manufacturer in India claims—"It is a powerful 16 bit system based on the Bit Slice Processor using advanced bipolar technology. We have reduced CPU cycle time—to 91 nanoseconds, memory chips are now twice as fast. Disc drives have been speeded up by 20%. Disc controllers by 20% and the disc capacity range increased to 400 Mb. On the software side the system now supports ANSI level 74, COBOL, in addition to BASIC. There is a new SORT/MERGE package".

Telecommunication Consultants India Ltd. (TCIL) a Govt. of India Enterprise recently has offered EP ABX system which facilitates transmission of voice, data, text and electronic mail. With suitable interfaces EP ABX can have access to 50 band telex network, 300 band EDX network and telephone network to integrate all these facilities with speed, code and protocol conversation. EP ABX can also be connected to a high speed packet switch data network, local area network and to a satellite.

In such technology huge machanisms have to be scaled down to manageable size, thousands of electronic components had to be fitted into a thumb nail space. This has been made possible by large scale integrated circuit (LSI).

Electronics circuit blocks (ECB) are used to manufacture quartz clock movements. SCL is the only organisation in India that makes LSI and LSI based models and substances for watches, clocks and computers.

One firm claims to have come out with a major breakthrough in indigenous microelectronic technology by which it has developed a diffusion capacity upto 10 cms wafers. It is proposes to manufacture over 200 million chips per year.

After mastering 5 micron silicon gate technology SCL has started R & D work on 3 micron and 2 micron technology.

Here are some information about spares :

A complete range of micro-processor and peripheral devices manufactured for the first time in India by SCL are as follows :

6502P —8 bit CPU
6522P —Versatile interface adapter
6532P —RAM, I/O, Timer
6545P —CRT Controller
6551P —Asynchronous Communications Interface adapter
6520P —Peripheral Interface Adapter
6500/I EB —6500/1, Packpack Emulator
6765P —Dual Density 8″ & 5¼″ floppy disc controller
6500/IP —Single Chip Microcomputer
10938P —Anode driver (5×7 dot matrix)
10939P —Grid Driver
6116P-2 —16 K Static Ram

ET & T recently has offered the following :

1. Computer Tapes, 6250 BPI, 727.27 mt. Rs. 255.00
2. Single side single density 20.32 cms hard sectored 384 KB Floppy Diskettes Rs. 51.00
3. Double side double density 20.32 cms soft sectored 1.2/1.6 MB capacity Diskettes Rs. 64.00
4. Double side double density 20.32 cms hard sectored Floppy Diskettes 1.6 MB capacity Rs. 69.00

At almost 1/4th the cost of new ribbons, one can get used computer ribbons re-inked from M/s Indian Carbons Company to make them as good as new.

The 7th Plan Period

During the terminal year of the 7th Plan Period, a production of over Rs. 10 thousand crores has been envisaged as against the current figure of about Rs. 2 thousand crores. The breakdown of Rs. 10 thousand crores are : components—2 thousand crores, consumer electronics—2 thousand crores, communication and broadcasting—3 thousand crores, aero-space—600 crores, control equipment—1 thousand crores, computer and office equipment—1 thousand crores. A centre for research and development in Telematics has been established to produce digital electronics exchanges.

A national Micro Electronics Council has been set up. Production of high power microwave tubes is being tried at BEL. Despite all these efforts proportion of electronics production in the country's GNP is about 0.8% as compared to 3 to 5% in some advanced countries. Compared to the modest growth of 12.9% during the previous year the growth rate achieved during 1984 was 39%. In consumer electronics sector the growth rate has registered 78%. The main contributing factors to this growth has been to increase production of T.V. sets (1.0 million B & W units in 1984, compared to 0.66 million units in 1983). The communication and broadcasting sector showed a growth of 18.7%. The aerospace and defence showed an increase of 18.3% while the computer and instrumentation sector showed an increase of 30%.

Nearly half office automation market today belongs to the plain paper copiers. Electro-photography (no darkroom, no chemical) was developed in 1939 in USA ; the same process was named Xerography in 1947 by Haloid Company of New York. Depending upon whether plain paper or specially coated paper, dry or liquid tonner are to be used, copiers may be divided into four main categories. Cost per copy from the copier using coated paper (Lenox, OCE, Encore etc.) is high. Liquid tonner transfer (LTT) process introduced by Ricoh and Cannon in 1960 produced satisfactory result only on extra smooth paper. Liquid tonner machine however have been loosing ground to the improved dry tonner machines. Different types of photo-receptor have been used e.g. selenium (most commonly used) CDS, organic photo conductor (ZnO belts) etc. suitability of a photo receptors depends to a great extent on the quality of the paper (electrically, chemically and physically), working temperature and humidity. In the cold pressure fusing process, the tonner powder is squeezed by high pressure rollers. A photo copier is "automatic" or "semi-automatic" depending on whether the originals are feed at one time or one by one. A machine can have "automatic magnification selection" capability by which it will select reduction and enlargement ratio to suit the copy paper selected. In a machine having "automatic paper feed selector" the correct copy paper will be automatically-fed from the paper tray. All sizes of originals will be copied on a single copy size and different original sizes will be converted to be copied on a single copy in an "automatic reproduction selector". The machine will stop when it is not used—"auto set off". "Bypass feed" allows to copy odd sizes. Tonner cartridges are available in different colours like brown, black, red, green and blue to facilitate colour production. "Diagnostic system" in a machine tells the nature of fault for the purposes of easy repairs. A machine having the facility of mounting two trays at the same time as a "dual paper tray" machine. Facility for darkening or lighting copy image is "cold exposure control". "Image shift" shifts images at copy paper to provide wider margin for binding. "Preselection" of copies enables one to select number of copies from 1 to 99. "Series copying" allows copying of books using A-4 size paper. Right and left pages of the book are copied on two separate A-4 size papers without moving the original. The "sorter attachment" enables to deliver copies separately from 10 to 20 bins from a set of originals so that sets are madé easily. "Magnification" may have a maximum of 7 steps of reduction ratio on the machine. In "zoom reduction" enlargement or reduction ratios are kept pre-set in 1% increments. The copiers may have different capacities—"high" (over 25 thousand copies per month), "medium" (upto 25 thousand CPM), "low" (upto 8 thousand CPM), "personal" (upto 6-800 CPM). Recent R & D works are going into development of high speed sophisticated really portable personal copiers.

The advertisement of one of the Indian portable photocopier suppliers goes—"place it right where the work is and relieve the strain on an over-burdened control copying department. In small offices it fits comfortably in just about any little niche. It can really be considered portable. At 18 kgs, it is light enough to be carried in a small attache-case by just one person". □

Interferon Prevents Viral Invasion

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FOR QUITE sometime scientists are frantically searching for the effective anti-viral drugs. Drugs which specifically kill the diverse forms of viruses infecting animals without interfering with the biochemical and genetic machinery of host's body cells will be sooner or later within our reach. Some spectacular successes in this direction are already being achieved with the drugs acyclovir, vidarabine, amantadine and interferon (*New Scientist*, Vol. *97*, No. 1348, pp 642-645, 1983). Of these, versatility of interferon as an anti-viral agent and a potential cancer drug is quite known to the scientific community.

Animals combat the viral attack with their immune system by making interferon—the natural anti-viral drug produced in the cells. On proper induction, almost all animal cells can synthesise interferon. Recent researches have shown that usually viral infection and treating cells with double-stranded ribonucleic acid (RNA) induce them to produce interferon. Besides these, many other substances, living as well as non-living, can also stimulate cells to synthesise interferon. These may be some bacteria reproducing intracellularly, some parasitic proto-zoans, the low molecular weight substances like antibiotics cycloheximide and kanamycin and also high molecular weight substances like lipopolysaccharides.

Fighting Viral Infection

Much knowledge have been accumulated in the recent years about the production and anti-viral action of interferon as also their underlying genetic control (*Science Reporter*, April and June, 1983). In fact, the exact mechanisms how interferon acts in fighting viral infection are yet to be fully understood.

A team of US researchers at Pittsburg University has recently worked out another anti-viral action of interferon which was not known earlier. This has added to the wide spectrum of mechanisms by which it combats viral infections. They have observed that interferon works as wakeful sentinel in animal cells to block the entry of viruses inside the cell's territory. Before this observation was made, it was thought, interferon can do little to block the initial entry of viruses into the host cells.

To enter into an animal cell a virus first binds itself to specific receptor molecules embedded in the host's cell membrane. The receptor molecules presume to be glycoprotein in nature. These molecules normally carry on some important function in the cell life. In the event of viral invasion, the viral coat proteins at certain sites (presumably developed on it) bind to the receptor glycoprotein molecules to make entry of virus into the host cell.

In all probability the mechanism of entry of viruses varies depending on viruses and host cells involved. The mechanism may be the direct penetration into the cell or fusion with cell membrane or by the process of endocytosis (Fig. 1). However, many evidence indicate that viruses invade the animal cells by endocytosis. Endocytosis is the process by which the animal cells normally take up materials from the surrounding environment. In case of virus entry also the cell membrane invaginates to form a deep pit enclosing the virus.

Ingenious Experiment

US team of investigators at Pittsburg University performed an ingenious experiment (*New Scientist*, Vol. *98*, No. 1356, P. 290, 1983) to prove that the entry of viruses in animal cells is also blocked by interferon by inhibiting the process of endocytosis at the cell membrane level. As a part of the experiment, they incorporated radioactive 'label' into the coat proteins of vesicular stomatitis virus. This virus is a causal agent of a mild disease of livestock and extensively used in researches on interferon.

The investigators determined the extent of labelled virus entry into the interferon treated cells. First, they added the labelled viruses to chick, mouse and human cell cultures. After sometime, to remove viruses bound outside the cell, cells were treated with an enzyme. This followed the purification and measurement of the radioactivity of these cells to ascertain the entry of labelled viruses. Through this experiment they could distinguish between the two different processes of adsorption of vesicular stomatitis viruses on the cell membrane, and their entry inside the cells. They observed although interferon treatment strongly inhibited the entry of viruses into the cell interior, the process of adsorption of viruses on the cell membrane remained unaffected. As an interpretation of their experimental result they inferred that in addition to previously worked out anti-viral action, interferon also inhibits the cellular activity of endocytosis—the process by which cell engulfs materials from its environment.

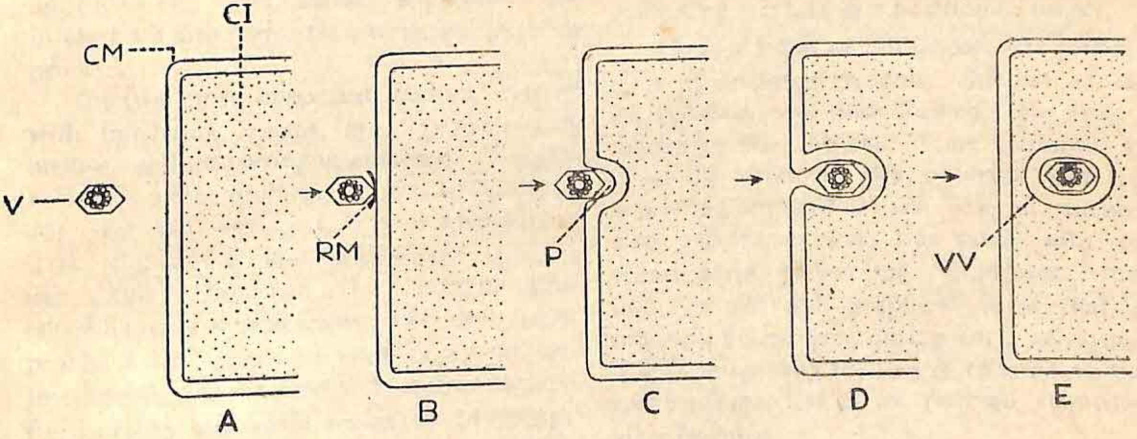

Fig. 1. Process of endocytosis (in a partially drawn animal cell).
A. A Virus (V) in the vicinity of a Cell ; B. A virus binds with receptor molecules (RM) ; C. Cell membrane (CM) folds inward at the site of binding to form a pit (P) ; D. Infolding of Cell membrane proceeds further to form a membrane bound vesicle around the virus and E. Vesicle containing virus (VV) breaks off and drops in cell-interior (CI) and cell membrane reseats.

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Two Areas of Difficulties in Educational Practices

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NOW A DAYS educational practices depend on various factors, such as, personality traits memorisation, evaluation and attainment, aptitude etc. The childs attentions and interest are also major factors in the learning process.

The two most important factors, related with imparting lessons, are involved with memory and measuring intelligence. Forgetfulness is a real problem in case of learning. All over the world, it is a contemporary item of research and discussions. I.Q. is not wholelly inherited ; it is largely influenced by environment factors like experience, problems of nutrition and many others. Intelligence is the potential base for successfull learning and achievement in education.

In this article, causes of forgetting and its remedies will be focused. The factor of intelligence is also illustrated with its forms, situation, measurement of I.Q. and classification of learners according to I.Q. and teaching devices for the various learner groups.

Causes of Forgetting

The contents which take a long time to learn are go out of active memory or are forgotten earlier. In this case repeatation during learning influence on forgetting ; overlearning, underlearning is a cause of forgetting. Neurotic difficulties in brain is also important factor in forgetting. New elements in the later stage of learning also create states of forgetting the previous contents as learned. The reaction or other activities or works is also a danger to memorisation ; pressure of work other than learning also causes forgetting. Fatigue turns down the active interaction necessary for learning. As the active intention is lost the contents learned is not maintained in the memory. The moment students learn something with the aid of punishment, he also forgets it as it is unpleasent experience and repress them in the unconscious. Mental activity is not negligible factor in relation to forgetting. The student's anxiety regarding his social security, pressure of tasks and economic security force him in a position to forget.

There is a test of Ebinghoss. He prepared a list of nonsense syllable. Sub-list of each 13 syllables was also formed. He tried to memorise the sub-list. Time required was 18 to 20 minutes. He observed less time was being required in each case of memorising. 20.5% of time was saved after one month during re-learning. Ebinghoss proves this fact through graphical curve that less time will be required during each relearning, that is, forgetting reduces in relation to time and we forget less as we proceed immediate after learning.

Strong and Boras introduced a equation showing the amount memorised after minutes/hours—R=A (amount in the memory after 1 minute/hour)—B (amount in the memory after 10 minutes/hours) X log t.

Teachers role against forgetting : The teacher is to maintain a responsibility so that the learner may accumulate his entire experience. With a view to follow it, they may take some measures and adopt techniques. Each lesson should be imparted by corelative teaching technique. Content of a lesson will be related with past experience and daily experience of life resulting in a meaningful lesson, which should be adopted according to the intelligence, age and past experience of the learner. Lesson should be imparted with gradation and repeatation. Teaching by Gestalt method, that is, from whole to part and use of teaching aids, other teaching techniques according to content, say cytology through heuristic method are to be applied. To avoid fatigue, time of imparting a lesson should be limited according to age, mental power i.e. attention and interest, and nature of subject matter. The lesson should be enacted with needs of the learner and the learners should be motivated. During application stage the teacher should create scope for learners to apply their experience and learned elements emerging re-call. In the class room same contents should not be imparted gradually that results inhibition.

Calculation of I.Q.

There is a scale of Binnet. On each unit an age is placed. For each age there are six questions. The learner should be asked to answer the questions related with the age two years under the real age. Of the age that all questions are answered by him is taken as Basal Mental Age. Then he should be asked to continue till he could not answer a single question. After testing the Basal Mental Age the learner is given one month mental age for answering correctly one question (from the mental age 2 to 4½ years) and he is given two months for the same reason (from 5 yrs. to general age level). So in this way total mental age may be calculated and the I.Q. will be as *Mental Age*÷Chronlogical age X 100.

Implication

According to I.Q. and other characters learners are classified. Gifted children's I.Q. is above 140. They can read rapidly and their sphere of studies is wide. They have strong memory and can memorise an item without repeated reading. Their stock of words are developed, they read more than the children of their age. Their handwriting is very developed and speed of writing is accountable, spheres of interest is wider than other students.

Through I.Q. testing, performance test, attainment test, experience and remarks of teachers they may be identified. They are also very creative. To foster their giftedness curriculum of elaborate studies, enhancing depth of knowledge and educational guidance are required.

There are under achievers also, who inspite of good I.Q., do not perform well in scholastic examinations. It is mainly due to lack of motivation and emotional disorder. They are identified by their weak ego control neurotic tendency, lack of confidence etc. The remedies are good counselling from the side of the guardians, to awaken their ability and confidence special efforts on the part of the teacher and special lesson may make them habituate for study and to give stress so that they can interprete the gist and theme of a a content rather than to understand are required.

Backward children having I.Q. 50-75 are called Educable Mentally Retarded. They can be successfull upto middle level of general education i.e. upto class eight. They are successfull in vocational education having medium standard of vocational work by average skill. These students prefer formal and concrete level of teaching and require drill work and individual attention.

Most of the students in our schools are Boarder Line Defective who's I.Q. is 75-120. They have problem solving power. They also have aptitude in science and power of simple arithmatical calculations. Graded lesson and demonstration method is appropriate for them.

In the begining of an academic session students of each class should be tested and according to I.Q., scholastic performance and teachers remarks they may be grouped as per theories stated in the previous paragraphs. Then according to their groups they may be taught by the teachers. Advanced methodology and science of education is accelerated by these procedures.

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Science News

Milky way's black hole

AFTER 10 years of research, astronomers have reported they have "Strong" new evidence of a massive black hole near the heart of the Milky Way galaxy. Black holes, which have captured the attention of the scientific community and the imagination of science-fiction writers are believed to be objects so compact that their gravitational pull allows nothing to escape—not event light.

Eight physicists and astronomers at the University of California, Berkeley, observed an enormous amount of material concentrated in the galaxy's centre, indicating the presence of an object four million times the mas of the sun.

"It is now clear the distribution of mass in the galactic centre is most unusual", said Nobel Laureate Charles Townes, head of the research team, "With this strong new evidence, the case for a black hole now seems quite convincing. Of course, we must all continue to examine it.

In the past there have been a number of puzzles about the galactic centre "The pieces of the puzzle that are finally falling into place with this key discovery are quite impressive." The findings were reported in the British science journal, Nature.

Scientists have long been trying to explain every high velocities and irregular motions of gas swirling around the galactic centre as well as extremely intense and unusual radiation coming from the region, 30,000 light years from the earth.

Many astronomers have interpreted the baffling signals as signs of radiation from objects being gobbled up by a massive black hole. However, they have had no clear-cut evidence. Instead of focussing on these signals, scientists have concentrated on motions of gaseous material that they hoped would give more definitive results.

The scientists used highly sensitive detectors of invisible infrated light to determine how fast blobs of gas whirl around the galaxy's centre. They found the farther the gas is from the centre, the slower it moves.

Overall, the gas whips around the centre at 160,000 km per hour to 60,000 kmph. The velocities determined were all consistent with a single mass at the centre, roughly four million times that of the sun.

The results also suggested that a huge quantity of gas sucked into the black hole might have triggered a violent explosion at the galaxy's centre in the past million years. Such a blow-up could account for the cavity scientists have detected extending to about 30 trillion miles from the centre. Until now, such measurements could not be made with adequate sensitivity and resolution.

New theory on formation of natural gas

PARTS OF comets, meteorites and other planets that struck the earth millions of years ago may have caused the formation of natural gas as well as the decomposition of plants and animals. If the theory is correct, Dr. Thomas Gold, a cornell university scientist predicts, substantial new discoveries will dramatically increase world fuel supplies and even the geographical distribution of natural gas.

Dr. Gold, believes that hydrocarbons which include methane, or natural gas, were formed deep inside the earth as result of such events. When 19th century scientists first postulated that hydrocarbons were produced organically they did not know that hydrocarbons could possibly be the result of cosmic events, he said.

Dr. Gold is known for his studies on topics ranging from the solar sytem to the working of the human ear, and he was the first scientist to explain pulsars—rapidly rotating neutron stars—and to deduce that the moon's surface was made up of a fine powdery dust long before astronauts landed there.

He also...pointed out that geologists in the Soviet Union are beginning to think much the same way as he does.

Swedish geologists plant to drill a 15,000-foot well in search of a pocket of methane, Dr. Gold told scientists at the concluding session of the annual meeting of the American Association for Advancement of Science.

Sweden, a country comprised mostly of granite rock and which contains little of the sediments known to produce methane, imports most of its fuel. Dr. Gold chose Sweden as the site for his dig because he believes the granite could be obstructing the upward movement of methane.

Tests so far revealed the presence of methane beneath the rock. Dr. Gold explained that all most all areas of deep ocean floor also had shown evidence of methane, and seismic data had also proved this.

Even if the controversial theory proves correct the question still remains on how to get methane from the ocean floor to the surface of the earth.

Dr. Gold proposes using a drilling plant that involves injecting warm water through pipes that extend deep deep into the ocean to force the methane upward. As the gas is pushed closer to the surface it can be retrieved in the usual way.

New finding on cervical cancer

CANCER OF the neck of the womb can be caused by a virus which is passed from men to women, reports British doctors.

Doctors have suspected for many years that cervical cancer may be a sexually transmitted disease. As long as 1842, a women's behaviour was recognized as a factor in the onset of the disease—it is very rare among nuns for example.

Studies since then have identified certain characteristics common among women at risk from cervical cancer these include an early age of first intercourse, having several sexual partners, an unstable marriage and suffering from venereal disease.

This pattern of social behaviour associated with the disease led doctors to suggest that the cancer might be caused by some unidentified infectious agent which was passed from men to women during intercourse. Such men might harbour this agent without themselves suffering any serious ill-effects from it. Recently attention has focussed upon the human papilloma virus (HPV).

Facial expression can influence physiology

TESTS SHOW that human are capable to using their facial expressions to influence their emotions, a phenomenon which he says can be manipulated to beat a lie detector test. "We know that if you have an emotion, it shows on your face. Now we have shown it goes the other way, too", Mr Paul Ekman, a professor of psychiatry at the University of California, Sanfrancisco, said "you become what you put on your face".

Tests on college students show that a happy face can produce a happy body, Mr Ekman told fellow researchers at the American Association for the Advancement of Science meeting.

Scientists have for long been able to measure the effect of emotions on the body by testing the heart rate, muscle tension, skin temperature and respiration.

Mr Ekman found that by coaching students to move their facial muscles in certain ways, they showed their bodies also acted as if the person were afraid, angry, disgusted or amused.

"It seems to be how we are worked up", Mr Ekman said. "If you laugh at suffering, you don't feel suffering inside. If your face shows sorrow, you do feel it inside."

Mr Ekman and his coleagues have linked facial expressions to seven emotions : fear, anger, disgust, sadness, amusement, surprise and contempt. However, they stopped short of recommending people smile. So far, their evidence is the weakest for the smile. That may be because there are 18 kinds of smile. One can smile in anger or have a sad smile.

The discovery may prove useful in medicine, but also gives a clue on how to beat lie detectors, Mr Ekman said.

The tests rely on subtle body reactions and Mr Ekman believes that by learning to change facial muscles, one can alter the responses the lie detectors pick up.

Lost world found in venezuela

REMOTE CLOUD-COVERED mountain in the jungles of southern Venezuela has provided scientists with a "lost world" where plants and animals have evolved in isolation since prehistoric times.

The Cerro De La Neblina—"Mountain of the Mists"—is not known to house any dinosaurs. But scientists who recently ended a year-long study there found dozens of previously unknown species.

Mr Charles Brewer Carias, the Venezuelan explorer, naturalist and former Youth Minister who coordinated the La Neblina study calls it "the largest multi-diciplinary expedition in the history of the natural sciences".

More than 120 Venezuelan, American and British scientists took part covering almost every speciality in botany and zoology. The specimens they collected range in size from microscopic fungi to snakes 20 feet long.

The institutions which took part in the La Neblina study include the National Geographic Society the Smithonian Institue and the American Museum of Natural History in the USA, and Venezuela's Central University and the Foundation for the Development of Physical, Mathematical and Natural Sciences. Money came from the National Science Foundation and the Venezuelan Environment Ministry.

By Mutual agreement half the specimens collected will go to the participating institutions abroad and the other half will remain in Venezuela.

The 9.885-feet high mountain is tucked away in the jungles near Venezuela's southern border with Brazil. Although it is the highest mountain in South America out-side the Andes, La Neblina was not discovered until 1953 by two American scientists. Mr Bassett MeGuire and Mr John Wordach.

In contrast to the humid jungles surrounding it, La Neblina contains a variety of tropical forest, habitats housing flora and fauna that have developed on their own for millions of years.

Most of the birds, mammals and amphibious reptiles are "cenozoic type things", which means they could have first appeared as long as 65 million years ago.

Some scientists speculate that in their ancestral forms, the reptiles, amphibians and insects date from the Mesozoic Era (between 135 million and 230 million years ago), when dinosaurs stalked the earth, and long before primitive man made his appearance.

Limits to earth's burden

A WORLD Bank background paper on rapid population growth and human carrying capacity shows differences among experts on how many humans the earth can support on a sustainable basis. But there is a broad agreement that there are limits and some countries have already passed that point.

The paper notes that civilizations have been wiped out because populations out stripped the capacity of earth to sustain them. The Mayan civilization vanished because population pressures caused deforestation and soil erosion resulting in the collapse of its agricultural system. Valleys in Greece that were once the site of some of the most intensive irrigated agriculture in the western world, will now support only scrub growth and grazing animals. During the days of Caesar, North Africa was the granary of the Roman Empire. Now it cannot feed itself.

The paper notes that the Ganga which flows through India and Bangladesh, floods annually causing millions of dollars of damage and incalculable human suffering. In the low and areas surrounding the Ganges, population growth and competition for land has forced many people to live too close to the river in the path of the annual floods.

In the mountainous watersheds of northern India and Nepal, population growth has led to severe deforestation causing the area's heavy rains to run off rather than soak into the soil. As testimony to the effects of population growth the severity of flooding has increased exponentially over the past 20 years even though the annual rain has remained essentially the same.

Experts disagree on the optimum limit of population for the planet as such. The answers range from 2,000 million to be several times that size.

The global population is already much above the maximum sustainable limit determined by some experts. It is now estimated at 4.845 million. China and the Indian subcontinent alone account for what is supposed to be the maximum for the world as a whole—1,042 million in China 762.2 million in India, 101.5 million in Bangladesh 99.2 million in Pakistan, 14 million in Bhutan, 17 million in Nepal and 16.4 million in Sri Lanka.

But the global capacity is meaningless because it is a world of Sovereign States, each of which limits or bars immigration. Each region and each country has to plan to live within its sustainable resources. Because carrying capacity cannot be increased forever, there is a compelling case for family planning on an urgent basis.

DNA extracted from mummy

SCIENTISTS HAVE extracted human genetic material DNA from a year-old Egyptian boy mummified around 400 BC and grown it in tissue culture in a laboratory, the British scientific journal, Nature, reported.

It is the first time scientists have been able to extract specimens of DNA from an ancient human or earlier primitive man and reproduce the genetic material in a controlled environment.

DNA, or deoxyribonuclaic acid, is the material in the nucleus of every cell in the body. It carries a complete blueprint of the genetic make-up of that individual.

The modern genetic engineering methods of cloning to reproduce DNA from specimens thousands of years old could have a profound impact on the study of evolution and archaeology.

Scientists led by Dr Svante Paabo of the University of Uppsala in Sweden, investigated 23 mummies for DNA content in a series of experiments studying evolution.

Comparing DNA taken from living organisms and dead organisms might sort out relationships between species and help scientists in trying to find out man's closest living relatives, such as the chimpanzee.

Many medicinal plants endangered

MANY MEDICINAL herbs and shrubs are fast disappearing from forests in Uttar Pradesh. There are about 250 economically important plants in the hill forests of the State of which about 100 species are in regular demand.

The average annual production of a dozen important special species, including berberies, *Gentiana kurro* (karwi) and *Sassurea lappa* (kuth) is about half a ton. Besides these 600 quintals of less important plants are exported annually. Minor forest produce such as medicinal plants, oilseeds, fruits, grasses and barks are found in the hill areas of the State. The resin, cleo gum extracted from the chir pine tree gives the maximum revenue.

A study shows that there are many factors for degradation of this resources. There is no systematic collection. There is an over-exploitation of popular medicinal herbs from accessible areas. However, the demand far outstrips the supply. No attempt have so far been made to farm these plants. The plants occurring naturally are picked. This exploitation has brought 15 species on the endangered list and as equal number may be threatened soon.

The study also shows that the system of picking medicinal plants is not scientific. The picking is done by local people who are exploited by middle-men. Another difficulty is that the pickers are untrained and do not recognize herbs. As a result many herbs are not picked or they are spoiled due to defective storing and drying.

The right to trade in medicinal herbs is purchased annually from the State forest department by contractors who in their turn procure the herbs from villagers.

It is proposed to create five medicinal herbs and minor forest produce development divisions with headquarters at Dehra Dun, Srinagar, Ranikhet, Renukoot and Jhansi. These divisions will collect data for other minor forest produce and evolve scientific methods of collection as well as establish demonstration farms.

Bananas may prevent gastric ulcer

BANANAS, contain certain chemicals which may prevent stomach ulcers and can help to alleviate its symptoms already formed.

The chemicals, as yet unidetified, have been found to prevent stomach ulcers in rodents, revealed experiments conducted by the scientists at Banaras Hindu University, Varanasi and Aston University, Birmingham.

The scientists found that the growth of mucus cells found in the stomach, is stimulated after treatment with the active chemicals. The new cells produce more mucus, which maintains the thickness of the protective barrier. This mucus flows into the ulcer creters and seals them from further attack by gastric juice, reports New Scientist a leading British science journal quoting the scientists.

It is known that the stomach wall is normally covered by a thin film of mucus secreted from the cells of the gastric mucosa. If the mucosa is damaged by drugs or disease, gastric juice can attack and erode the unprotected cells, thereby forming ulcers.

Professor A.K. Sanyal who conducted the experiments at BHU found that all bananas do not possess anti-ulcerogenic chemicals. Bananas which are unripe and picked five weeks before ripening and powdered, only contain the anti-uncerogenic substances.

The Aston scientists, the journal says, managed to extract the active anti-ulcer compounds from samples of banana powder sent from India by Professor Sanyal. The end product was 300 times more active than the original powder. Professor Sanyal tried banana powder therapy on human volunteers who were given four grams of the powder each as part of their treatment. □

Book Reviews

Unit 23 : Computers and Learning

by
Sophie McCormik *et. al.*
Open University Press, Milton Keynes, 1983
Pages 70. Price £ 5.50

To those who are not particularly familiar withthe Open University series on Educational Studies, the format of this book under the Block on Teaching, Learning and the Curriculum may appear a bit foreign. But it is a very cautious account of possibilities and limitations computers as learning aids in any part of the globe.

While distinguishing between computer-managed learning (CML) and computer-assisted learning (CAL), the auther describes the uses of CAL in the classroom for collation and display, calculation, storage and data retrieval, data capture, simulation and modelling. There are practical suggestions on the design of the CAL material, use of the computer in large classes, time and training and suitability of software; all this should be useful to the classroom teacher.

With objectives of the book clearly mentioned, there are hints on development of CAL units and a thorough discussion (with examples) on CAL and the process of *discovery* which may a theorist has emphasised as a superior method of learning.

Although many people believe that there is no relevant learning theory to guide the administrator and user of computers in school education, the authors muster arguments from Piaget and Bruner to justify the possible useful role of computers in learning. However, the reader may not always agree with McCormik and her coauthors on "correct" interpretation of Piagetian theory.

Still more important feature of this book is that it expects, for very good reasons, the teacher to be a curriculum planner and curriculum developer. While this is desirable, and workable in a decentralised system, much of this role of the teacher is not feasible at this moment in the set up of Indian school education which is essentially centralized and yet fragmented. A certain degree of programming ability would also be required for the teacher to play the role suggested by the authors of this book.

Yet, the precise ideas presented in this Open University Publication would make the reader think and try to attain some of the objectives which are aimed at through this book.

An Indian edition would be within the reach of individual teachers. □

Young Learners and the microcomputers

by
Daniel Chandler
Open University Press, Milton Keynes, 1984
Pages 131, Price £ 5.95

Dramatic in style and treatment, this book is unique in many ways but particularly for the author's critical appraisal of the manner in which microcomputers are generally used in schools in the UK and USA. The author also offers pointers to ways in which computers can be used at schools to provide an extension to the learning opportunities open to the children (computer-*extended* learning).

Written by a teacher of English language, the first 5 chapters should be an essential reading for the neoliterate in computers. One can see much of flowcharting, word processing or LOGO graphics in wider educational perspectives through these chapters. Chapter 3 on word processing and chapter 5 on how to control the computer would be particularly interesting.

With issues, arguments and counterarguments, and with Ivan Illich and Jean Piaget, the rest of the book is more serious stuff. Chapter 6 and 7 are sure to offer an enriching and celebrating experience to anyone who knows that 'thinking about the computer's role in education does not mean thinking about computers, it means thinking about education'. This should be adequate reason why every school library should have this book.

Appendix 1 (Choosing Software : a Checklist) and the Glossary of Terms Used in Educational Computing should be useful for the beginner and the expert.

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AN ANNOUNCEMENT

The forthcoming apparition of Comet Halley is attracting increasing amount of attention of general public and in particular students and laymen who have some interest in astronomy. A large number of enquiries from amateures and others who own telescopes, etc are reaching us seeking guidance on where and how to see the comet and also how to plan observations.

Several astronomers are making best efforts to educate the general public by writing articles in newspapers or giving popular lectures. In addition the need is realised for the dissemination of information on the comet and in detail giving in particular methods of its observation for the benefit of amateurs who are planning these systematically and also for putting them in touch with each other. To meet this demand, we are happy to inform that a circular titled "Communication on Comet Halley" has been started. The first issue was published and distributed towards the end of July 1985. The second issue is expected to be available by the end of September. Till May 1986 about 10 issues of Communications on Comet Halley are planned ; although, they may not be a regular publication. The publication of this has been possible due to the kind support received from ISRO.

The Editorial Board comprises Prof. K.R. Sivaraman, Chairman of the Steering Committee of the Indian Halley Observation Programme. Indian Institute of Astrophysics, Bangalore; Dr. A G Kulkarni, Director, Sardar Vallabhbhai Patel Planetarium, Baroda; Mr. Bharat Adur, Scientist, Nehru Planetarium ; Mr. Raju Patel, Amateur astronomer, Bombay and myself as Convener. This circular is being distributed to planetaria, amateur astronomy associations and science clubs who are known to us to have plans for observing Comet Halley. In addition, this is also being distributed to selected schools, colleges and university physics departments, as advised by Kendriya Vidyalaya Sangathan, NCERT and UGC.

Amateur observer groups, schools and colleges who have systematic plans to observe comet but have not received intimation so far could contact following address for a copy by giving information on the observations planned, instruments likely to be utilised and approximate number of observers in the group.

Dr. M.K. Tiwari
Convener, CCH
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Cauvery Bhavan
BANGALORE-560009.

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Further details may by obtained from

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GIVE BACK OUR SKY

Our sky-line is diminishing gradually. Often the sky-scrapers, multi-storied buildings, smoke oozing chimneys have engaged our sky-line, to such an extent, that it is often not visible.

Give back our sky, as nature gave it to the mother earth. ...The blue sky, sometimes with silvery clouds, sometimes with glittering stars ! Give back the planet earth,its old glory.

We—the mankind want to survive on this planet. Give us a pollution-free environment.

The cover of this issue is not merely a sketch or painting. It is, infact, a protest against our diminishing sky-line. It is also a call to the mankind to save the environment.

विद्ययाऽमृतमश्नुते

एन सी ई आर टी
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